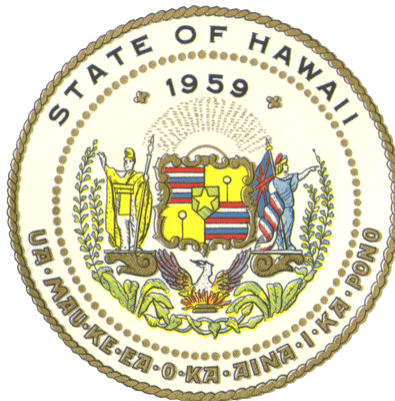


**REPORT TO THE 22ND LEGISLATURE
REGULAR SESSION OF 2004**

**FINAL REPORT ON
THE USE OF ALTERNATIVE ENERGY SOURCES TO
ADDRESS ENERGY NEEDS ON THE ISLAND OF
KAHOŌLAWĒ**



**PREPARED BY
THE DEPARTMENT OF LAND AND NATURAL RESOURCES
AND
THE KAHŌŌLAWĒ ISLAND RESERVE COMMISSION
IN CONJUNCTION WITH
THE KAHŌŌLAWĒ ISLAND RESERVE ALTERNATIVE ENERGY TASK FORCE
IN RESPONSE TO
SENATE CONCURRENT RESOLUTION NO. 101, SENATE DRAFT 1**

NOVEMBER 2003

EXECUTIVE SUMMARY

This final report has been prepared in compliance with Senate Concurrent Resolution NO.101 Senate Draft 1, adopted by the Twenty-First Legislature, Regular Session of 2002. The Concurrent Resolution requested that the Kahoʻolawe Island Reserve Commission (KIRC) convene an alternative energy task force to include members from the Hawaii Natural Energy Institute, the Pacific International Center for High Technology Research (PICHTR), the Natural Energy Laboratory of Hawaii Authority, the Protect Kahoʻolawe ʻŌhana, and the State of Hawaiʻi – Department of Business, Economic Development & Tourism. The Concurrent Resolution further requested that an interim report be provided to the 2003 Legislature and a final report to the 2004 Legislature.

Since its inception in 1993, the KIRC has been responsible for the environmental restoration, preservation of archeological sites, and cultural education on Kahoʻolawe. The KIRC has already completed a Use Plan, an Environmental Restoration Plan, an Ocean Resources Management Plan, and an Access and Risk Management Plan for the Reserve. The plans call for establishing cultural education centers on Kahoʻolawe that will serve as centers for carrying out the environmental restoration, marine resources protection and restoration, protection of archeological sites, and providing cultural education on the Island. In November 2003, the U.S. Navy led Ordnance Clearance Project will be completed and the access control to Kahoʻolawe will be transferred to the State of Hawaiʻi. After this date the KIRC will be responsible for the total management of the reserve including access control.

The task force submitted an interim report to the Legislature providing an assessment, a cost analysis, and an implementation strategy to meet the energy needs for the environmental restoration work being carried out on Kahoʻolawe. The interim report summarized the planning for future that the KIRC has already carried out and recommended follow-up actions regarding future energy needs. The task force recommended establishing additional data collection sites for wind and solar energy, developing a model encampment, and carrying out ongoing evaluation of long-term alternative energy sources. The task force also recommended that the 2003 Legislature provide \$500,000 to PICHTR to undertake the follow up actions recommended in the interim report.

During the Twenty-Second Legislature Regular Session of 2003, Senate Bill (SB) 848 and House Bill (HB) 198 were introduced to appropriate funds to implement a strategy for the use of alternative energy resources on Kahoʻolawe. Both bills have been carried over to the 2004 regular session.

Without the funding, the task force has not been able to implement the recommendation from the interim report. The task force again recommends that the 2004 Legislature provide \$500,000 to PICHTR to undertake the follow-up actions recommended in the interim report.

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1.0 INTRODUCTION

Senate Concurrent Resolution (SCR) No. 101, Senate Draft 1 (SD1) was adopted by the Twenty-First Legislature, Regular Session of 2003 requesting the Kahoʻolawe Island Reserve Commission (KIRC) convene a task force to include members from the Hawaii Natural Energy Institute (HNEI), the Pacific International Center for High Technology Research (PICHTR), the Natural Energy Laboratory of Hawaii Authority (NELHA), the Protect Kahoʻolawe ʻŌhana (PKO), and the State of Hawaiʻi – Department of Business, Economic Development & Tourism (DBEDT).

The Concurrent Resolutions also requested that the task force collaborate with the aforementioned entities to develop a plan that includes a cost analysis, an assessment, and an implementation strategy for the utilization of alternative energy resources to address the current and future energy needs of the Island of Kahoʻolawe; and to submit an interim report of its findings and recommendations to the Legislature prior to the convening of the 2003 Regular Session, and a final report prior to the convening of the 2004 Regular Session.

On June 27, 2002, the KIRC formally established the Task Force on Alternative Energy (Task Force). Consequently, the KIRC Staff convened the first meeting of the Task Force on September 6, 2002 at the Department of Land and Natural Resources Boardroom. In attendance were: Mr. Keoni Fairbanks, Executive Director - KIRC; Mr. Deepak Neupane, PE, Senior Program Manager – KIRC; Dr. Richard Rocheleau, Director – HNEI; Mr. Jeff Smith, Executive Director – NELHA; Mr. Harold Masumoto, President and Chief Executive Officer – PICHTR; Mr. Keith Matsumoto, Vice President, Chief Operating Officer & Treasurer – PICHTR; Mr. Derek Mar – PKO; and Mr. Maurice Kaya, Energy Program Administrator – DBEDT, Energy Resources & Technology Division.

The Task Force conducted several meetings that has resulted in this interim report of the Kahoʻolawe Island Reserve Task Force on Alternative Energy.

2.0 BACKGROUND

The Kahōjōlawe Island Reserve, located 94 miles southeast of Oahu and 6 miles southwest of Maui, contains approximately 28,800 acres. It is 11 miles long, 7 miles wide, and has a peak elevation of 1,477 feet.

Kahōjōlawe is of great significance to native Hawaiians and others who, in addition to acknowledging its importance in yielding data regarding Hawaiian cultural heritage, consider it a significant symbol of cultural survival and regeneration. It is considered to be a *wahi pana* -- a sacred place -- to be used for education, awareness, and experience in Hawaiian culture, as a place to carry on traditional customs and practices, and as a *pu`uhonua* -- a place of refuge and spiritual regeneration.

Traditional accounts indicate that Kahōjōlawe was closely associated with several deities, including Kanaloa, the god of the ocean, the deep sea, and of navigation and carving. Kahōjōlawe is thought to have been an ahupua`a of Maui and to have been divided into smaller sections called `ili which were occupied and worked. As many as 100 or more people may once have lived at Hakioawa, the largest settlement on the Island. The archaeological and historic resources of the Island are valuable treasures that provide insight into the Island and its past inhabitants.

Mojolelo, mele, and archaeological data provide the background for what is known about the pre-contact period on Kahōjōlawe. Hawaiian traditions (especially the tradition of La`amaikahiki) link Kahōjōlawe with the South Pacific voyaging tradition that resulted in the introduction of a new ruling class, new gods, and a more stratified society around 1200 AD.

Most prominent western scholars believe people from East Polynesia originally settled in the Hawaiian Islands between A.D. 200 - 500. This is evident by the Hawaiian language, culture, social organization, and technology. The original settlers brought with them domestic plants and animals: sweet potatoes, taro, pigs, dogs, and chickens.

Archeologists believe the pre-contact history of Kahōjōlawe began around A.D. 1000, based on radiocarbon dates from habitation sites. Small communities were established along the coast. In time, greater use of inland areas occurred for cultivation of dry-land crops and adz quarrying, and the original dry forest environment changed to an open savannah of grassland and trees as a result of vegetation clearance for firewood and agriculture. From approximately A.D. 1500 - 1600, dry-land agriculture was practiced on a small scale on inland slopes and coastal gulches.

Geographically, Kahōjōlawe was a distinct ahupua`a of the Honua`ula moku district on Maui. The ahupua`a of Kahōjōlawe was subdivided into smaller land divisions called `ili, which were occupied and worked by commoners. Kahōjōlawe was probably managed by a local chief representing the Maui district chief. Traditional accounts indicate the inhabitants of Kahōjōlawe maintained close ties to Maui. Estimating the population of Kahōjōlawe is difficult, but reportedly the maximum population was no more than a few hundred during this period.

It is evident that Kahoʻolawe was once divided into twelve ʻili; however, the exact boundaries of each ʻili are not defined. The boundaries of the twelve ʻili were approximated and consolidated into eight contemporary ʻili on the Kahoʻolawe Use Plan Land Use Map. Lua Makika, the highest point on the Island is viewed as the piko or center of the Island from which most of the ʻili radiate.”

From 1779 to 1841 Kahoʻolawe is described by various sources as having a small population, estimated at below 100, with fishing as the main economic activity. In the 1790’s, Captain Vancouver gave goats to the Maui chief Kahekili as a gift. Kahekili reportedly took some of these goats to Kahoʻolawe to multiply.

In 1848, Kamehameha III initiated the land reform known as the “Great Māhele.” The traditional Hawaiian concept of land stewardship was replaced by the western legal concept of land ownership. Ownership of lands was divided between the King and his Aliʻi, with portions set aside for government use and processes established for private individuals to be awarded land. Kahoʻolawe was considered land of the government. In 1858, the government issued the first of many ranch leases for the Island. The number of sheep and wild goats (introduced prior to 1858) soon grew to be a problem as early as 1875; parts of the Island were denuded due to overgrazing.

Under the joint resolution of annexation, approved July 7, 1898 and pursuant to the Hawaiian Organic Act of 1900, the Island was ceded and transferred from the Republic of Hawaii to the United States. Title to Kahoʻolawe was held by the United States after Hawaii’s annexation in 1898. Under the Organic Act of 1900, the territorial government was authorized to use and possess the Island until the federal government acted. Kahoʻolawe continued under territorial management with a ranch lease until 1910.

Cattle and sheep were introduced to the Island within the first 50 years of ranching. Goats were introduced to the Island more than 60 years before the ranching period. Throughout the ranching periods, the uncontrolled grazing of sheep, and goats had a serious impact on the environment of the Island and resulted in substantial loss of soil through accelerated erosion. During the late 1890’s, there were reported to be 900 cattle and 15,000 sheep on the Island.

The Territorial Board of Agriculture proclaimed the Island a forest reserve in August 1910. Re-vegetation efforts were met with little success, and since the forest reserve designation prohibited the hunting of goats on the Island, the proliferation of goats continued to degrade the island.

Realizing that the goats represented the major threat to the Island and that forestry efforts were futile in the presence of goats, the Territorial Governor withdrew Kahoʻolawe from its forest reserve designation in 1918 and transferred the Island to the Commissioner of Public Lands for management purposes.

In December 1918, the Commissioner of Public Lands leased the Island to cattle ranchers -- Eben Low and Agnus MacPhee. Low, MacPhee, and Harry Baldwin formed Kahoʻolawe Ranch, which continued as lessee until 1952. In an effort to control the goat population and soil erosion, the Commissioner of Public Lands required Kahoʻolawe Ranch to eliminate the goats, limit cattle to no more than 200, and encouraged the use of the non-native tree, kiawe (*Prosopis*

pallida), in re-vegetation efforts. The ranch headquarters was built at Küheia and a water system of cisterns was established.

In May of 1941, Kahōjōlawe Ranch signed a sublease for a portion of the island with the U.S. Navy for \$1.00 a year up to 1952 when the Ranch's lease expired. Seven months later, on the day following the Japanese attack on Pearl Harbor, the Territory of Hawai'i was placed under martial law. The military took over the entire island, and ranching operations ended.

Ship-to-shore bombardment of the Island commenced in 1941 and intensified starting on October 21, 1943, when the USS Pennsylvania conducted rehearsals for the Gilbert Islands invasion. In preparation for additional landings across the Pacific, the Navy ran ship-to-shore fire control training operations at Kahōjōlawe. From 1942-1943, American submarine commanders tested torpedoes by firing them at the shoreline cliffs at Kanapou. Additional torpedoes were test fired from 1943 to the 1960's.

Under Executive Order 10436, signed on February 20, 1953, President Dwight D. Eisenhower reserved the Island for the use of the United States for naval purposes, except for 23.3 acres on the southern end previously reserved for lighthouse purposes. The Order directed the Navy to eradicate, or reduce to less than 200, all cloven-hoofed animals; to allow the Territory of Hawaii to initiate soil and reforestation studies; and, when the Island was no longer needed for naval purposes and without cost to the Territory of Hawai'i, to render the Island reasonably safe for human habitation.

In 1976, the members of the Protect Kahōjōlawe ōHana (PKO) filed suit in Federal District Court, *Aluli et al. V. Brown*, seeking to enjoin the Navy's bombing activities on Kahōjōlawe. In 1977, the Federal District Court ordered a partial summary judgment in favor of *Aluli et al.*, and the Navy was required to conduct an environmental impact statement and supply an inventory of, and protect, the historic sites on the Island.

In 1980, a settlement Consent Decree and Order was reached in the *Aluli et al. v. Brown* civil suit. Under the Consent Decree and Order, the Navy agreed to survey and protect historic and cultural sites on the Island, clear surface ordnance from 10,000 acres, continue soil conservation and re-vegetation programs, eradicate the goats from the Island, limit ordnance impact training to the central third of the Island, and allow monthly PKO accesses to the Island. Through those monthly accesses, the PKO has regularly visited the island for religious and cultural purposes, as well as re-vegetation and conservation programs.

On March 18, 1981, the entire Island was listed on the National Register for Historical Places and designated the Kahōjōlawe Archaeological District. The Kahōjōlawe Archaeological District contains 544 recorded archaeological/historical sites and over 2,000 features, as well as previously unrecorded features associated with traditional and historic Hawaiian land use, ranching, and military activities.

In 1990, President George Bush issued a Memorandum to Secretary of Defense, Richard Cheney, which directed the Secretary to discontinue use of Kahōjōlawe as a weapons range effective immediately. Section 8118 of Public Law 101-511, enacted by Congress in 1990, established the Kahōjōlawe Island Conveyance Commission to recommend terms and conditions for the conveyance of Kahōjōlawe from federal jurisdiction to the State of Hawai'i.

The law prohibited the use of the Island for weapons delivery training until after the final Kahōjōlawe Island Conveyance Commission report was delivered to Congress. The Commission submitted its final report with findings and recommendations to Congress in March 1993, and dissolved six months later in September 1993. During the same period, the Navy in consultation with the State Historic Preservation Division of the Department of Land and Natural Resources, the Protect Kahōjōlawe ōhāna, and the County of Maui met and developed a Cultural Resources Management Plan for the Kahōjōlawe Archaeological District. That document was finalized in January 1995.

3.0 ORDNANCE CLEAN UP BY THE U.S. NAVY

In 1993, Senator Daniel K. Inouye of Hawai'i sponsored Title X of the Fiscal Year 1994 Department of Defense Appropriation Act (PL 103-139, 107 Stat. 1418, 1479-1484). Title X authorized conveyance of Kahōjōlawe and its surrounding waters to the State of Hawai'i. It also provided for the "clearance or removal of unexploded ordnance" and environmental restoration of the Island, to provide "meaningful safe use of the Island for appropriate cultural, historical, archaeological, and educational purposes, as determined by the State of Hawai'i."

Hawaii Revised Statutes, Chapter 6K, created the Kahōjōlawe Island Reserve Commission (KIRC) to have policy and management oversight of the Kahōjōlawe Island Reserve. The statute requires that the Island (including waters extending seaward two nautical miles from the shoreline) be used solely and exclusively for the following purposes:

- 1) preservation and practice of all rights customarily and traditionally exercised by the native Hawaiians for cultural, spiritual, and subsistence purposes;
- 2) preservation and protection of its archaeological, historical, and environmental resources;
- 3) rehabilitation, revegetation, habitat restoration, and preservation; and
- 4) education.

Additionally, the Island is to be preserved in perpetuity for the above uses; commercial uses are strictly prohibited.

As directed by Title X, a Memorandum of Understanding (MOU) between the Navy and the State of Hawai'i was prepared to govern the conveyance of the Island to the State of Hawai'i with six specific agreements (regulatory framework; site protection; public participation; security; emergency communication; and regular interval clearance and removal of newly discovered, previously undetected ordnance). The Navy and the Governor of the State of Hawai'i executed the MOU on May 6, 1994. Pursuant to Title X and the MOU, title to the Island of Kahōjōlawe was transferred to the State of Hawai'i on May 7, 1994.

Under the MOU, the Navy retains access control to the Island until clearance and environmental restoration activities are completed, or November 11, 2003, whichever comes first. The State, through the KIRC, is the primary stakeholder and landowner, responsible for the long-term restoration and management of Kahōjōlawe for appropriate cultural, historical, archaeological, and education purposes. The State holds statutory, regulatory, and enforcement interest in the protection of public health and the environment. The regulatory process set forth in the MOU maintains that the Navy shall proceed with the cleanup in consultation with the KIRC and in a manner consistent with the National Oil and Hazardous Substances Pollution Contingency Plan.

On December 13, 1996, the Naval Facilities Engineering Command, Pacific Division, solicited a Request for Proposals to conduct unexploded ordnance clearance and environmental restoration of Kahōjōlawe Island -. The Clearance Contract was awarded to the Parsons-UXB Joint Venture (PUXB) on July 29, 1997.

The current Navy cleanup work will end on November 13, 2003 and the KIRC will control access to the Island. Based on current Navy projections, a total of 19,500 acres on the Island will be cleared of surface ordnance, out of which 2,500 subsurface acres will be cleared.

4.0 PLANNING FOR THE FUTURE

4.1 KIRC Vision Statement

The kino of Kanaloa is restored. Forests and shrublands of native plants and other biota clothe its slopes and valleys. Pristine ocean waters and healthy reef ecosystems are the foundation that supports and surrounds the island.

Na po'e Hawai'i care for the land in a manner, which recognizes the island and ocean of Kanaloa as a living spiritual entity. Kanaloa is a pūyuhonua and wahi pana where Native Hawaiian cultural practices flourish.

The piko of Kanaloa is the crossroads of past and future generations from which the Native Hawaiian lifestyle spreads throughout the islands.

This vision statement projects the vision for the long-term future condition of the environment and ecosystems of the Kahoʻolawe Island Reserve, for the continuing involvement of the people of Hawaiʻi in caring for the Island, and how Kahoʻolawe can help in the spread of indigenous Hawaiian culture and its perpetuation to future generations.

The first paragraph of the vision statement refers to the physical as well as spiritual restoration of Kanaloa (Kahoʻolawe). Kanaloa is one of the four major Hawaiian gods. He is the god of the deep foundations of the earth, the ocean (and all things related such as navigation), ocean animals, and fresh water found underground. The Island of Kahoʻolawe was named for the god Kanaloa.

Accomplishing restoration and re-vegetation envisioned in this statement will be a long and arduous task. For the foreseeable future, much of the activities occurring on the Island will revolve around restoration. Moreover, Kahoʻolawe presents the people of Hawaiʻi with a unique and historic opportunity to revitalize the Island with native plants and biota in an isolated setting and to create a marine sanctuary that can also help regenerate marine life for Maui and Lanai.

The second paragraph acknowledges the traditional role of Kahoʻolawe as envisioned by Hawaiian ancestors as a sacred form and refuge of the life force and energy of Kanaloa. Kahoʻolawe is a cultural treasure for all the people of Hawaiʻi, especially na poʻe Hawaiʻi (the Native Hawaiian people). There are few places left in today's Hawaiʻi where one can go to learn about being Hawaiian. Kahoʻolawe offers such a place.

Restoring the Island will provide a place and a purpose for a new generation of Hawaiians to be trained in both the rights and responsibilities of "kahu o ka ʻāina" (stewards of the land). This involves learning to care for the natural resources, only taking what is needed, and observing a kapu to allow the resources to naturally regenerate from season to season and year to year.

The Island will provide a place for Hawaiians and other kamaʻāina who see Hawaiʻi as their homeland to experience the intimate connection to the land, the sea, the kupuna (ancestors), and the akua (gods). Hawaiian arts and sciences related to traditional navigation, fishing, cultivation,

etc. will be taught to new generations. Thus, Kahojōlawe will be a cultural learning center where traditional cultural and spiritual customs, beliefs, and practices of the Hawaiian people can take firm root and flourish.

Traditionally, Kahojōlawe served as the navigational center or piko and crossroads connecting Hawaiians to their ancestral homeland, Tahiti. The Kealaikahiki Channel aligns with the north-south Kane- Kanaloa line at the zenith of the heavens, dividing east from west. In aligning the stern of a voyaging canoe in the Kealaikahiki channel with Lae O Kealaikahiki on Kahojōlawe, Pu'u O Hoku on Molokai, and Hoku Pāa (the North Star) a navigator can set a straight course for Tahiti.

For contemporary Hawaiians, Kahojōlawe serves as the piko for the regeneration of Hawaiian spiritual, cultural and subsistence practices. As more and more people of Hawai'i are able to touch and be touched by the Island and experience Hawaiian cultural practices, the Native Hawaiian lifestyle will spread throughout the Islands. Again, the KIRC and State of Hawai'i have a unique and historic opportunity to enhance the recognition and perpetuation of the culture indigenous to the Hawaiian Islands and existing nowhere else in the world.

4.2 Uses and Anticipated Activities

The following use categories are planned for the Island and are discussed in the Kahojōlawe Use Plan:

- Kahua Kauhale (Educational and Cultural Centers/Work Camps)
- Kahua Hojōmoana (Overnight Campsites)
- Ho'ola Hou (Revegetation/Soil Stabilization Areas)
- Kula (Open Lands)
- Kahua Kahiko (Cultural/Historical Preserves)
- Na Mea Kanu/Na Holoholona A Me Na Ija (Botanical/Wildlife Preserves)

Fishing and ocean gathering activities are cultural uses and are expected to occur along the entire coastline. Fishponds have been investigated as a possible use; however, at present there are no known traditional fishponds and the existing conditions are not conducive to the creation of new fishponds. The possibility of re-establishing or creating fishponds in the future and other ocean use issues has been studied in the Ocean Management Plan.

4.2.1 Kahua Kauhale (Educational and Cultural Centers/Work Camps)

In order to support larger groups for Island introductory or longer-term visits for apprenticeship or project specific uses, as well as work groups for restoration activities, kahua kauhale (educational and cultural centers) will be established in bay areas at Hakioawa, Kuheia and Kaulana, Ahupu, Honokanaija, and inland at Lua Makika. These kahua kauhale will each have local sources of water via catchment, well, or desalinization techniques. The inland kahua kauhale would also have a back-up system of imported water. A shoreline and mauka-makai trail system would connect these centers to each other and to other parts of the Island. A permanent buoy mooring would be placed in each of the above-mentioned bays to afford safe access. These

centers are where the kahu (steward of the land and cultural master) could reside with his or her family and where students and other visitors would spend most of their nights.

Therefore, in addition to water sources, most kahua kauhale will have a permanent house (with its own sleeping area, kitchen, lua, storage, etc.) for the kahu and his or her family to live as well as facilities to accommodate apprentices, restoration teams, and other visitors. The design and structure of the facilities will vary in each of the areas selected for a kahua kauhale, according to its historical use and its environment. Hakioawa will remain as it is, with very simple and basic camping facilities. The buildings and facilities at Honokanaiya could remain and new structures, more appropriate in design and function, will be added. Foundations of former ranch structures could be used to rebuild facilities for Kuheia. The structures at Lua Makika will be designed to facilitate implementation and training in celestial navigation, and natural resource restoration and management.

The general facilities in each kahua kauhale will include the following features: sleeping areas or structures; a central kitchen; a central gathering area or structure; an imu; a fireplace for outdoor cooking; a fireplace for burning of combustible wastes; a storage area for sorting and holding other wastes for off-island disposal; a garden for food plants; planting areas for multiple use plants such as wauke for tapa or ipu for gourds; a composting area; lua; storage sheds for tools, equipment, supplies, and assembling materials; and halau waya (canoe houses) or pa waya (canoe enclosures).

To accommodate the kahu and for general uses, a solar electric system and a means of communication will also be included. Helipads and land access to the helipads will be provided in each kahua kauhale for emergencies and other transportation needs.

4.2.2 Kahua Hojomoana (Overnight Campsites)

Kahua hojomoana, similar in nature to kahua kauhale, will be used for cultural, educational, and restoration purposes, but with lesser improvements. In general, kahua hojomoana are designated to provide good resting places and smaller overnight campsites in between shoreline destinations or between coastal and upland destinations. Kahua hojomoana also provide remote and unimproved areas for smaller groups and more intensive subsistence experiences. Thus, kahua hojomoana will be established along the shore near a shoreline trail system, such as at Keanakeiki. Additional areas may be designated later depending upon the future kahu. These kahu will have to learn from the Island where the various resources are located and what cultural and educational needs exist.

Many kahua hojomoana will have no facilities; however, depending on intensity of use, some kahua hojomoana will include minimal facilities such as a lua, a pa waya, a cooking area, and a storage shed for basic fishing, camping, and first aid supplies. A potable water supply and delivery system could also be developed if feasible and appropriate to the environment of each particular site.

4.2.3 Hojola Hou (Revegetation/Soil Stabilization Areas)

The importance of restoration of the Island cannot be over-emphasized. Past activities, including ranching, bombing, and large populations of feral animals, have completely altered and severely degraded the Island's environment. Restoration of the Island to the condition described in the vision statement consists of four strategies 1) control of erosion, 2) revegetation, 3) enhancing water table recharge, and 4) replacing exotic plants with native species. Projects will include soil conservation structures such as settling ponds, check dams, down slope reservoirs, terracing, climatological monitoring stations, irrigation, and extensive planting of native grasses, vines, shrubs, and trees. The KIRC restoration/revegetation strategy will propose specific projects. The critical areas in need of this attention are the uplands, especially the hardpan area, and the heads of gullies.

4.2.4 Kula (Open Lands)

Kula designates the open areas over the majority of the Island that will have limited public access and lower intensity human use. The Kula is a natural area where the pueo live and individuals can have a "wilderness experience." However, the need to stop erosion and revegetate much of this area implies intensive human activity for the next several decades.

Once the area is restored and revegetated with native plants, cultural use of these areas will continue by those who are staying in the kahua kauhale.

Throughout the Island, plant cultivation or stonework activities may occur for subsistence, cultural, or educational purposes. Stonework may also occur for restoration purposes. The types, locations, amounts, and parts of plants that can be gathered will be determined according to the success of restoration activities and the sustainable yield of the item sought.

Traditional crops that were once cultivated on the upland slopes of the Island include 'uala (sweet potato) and ko'ula (sugar cane). The type of crops to be cultivated in the future will be determined according to viability, use, compatibility with restoration, and water availability. At this point, specific land requirements are access trails to gathering areas.

4.2.5 Na Mea Kanu/Na Holoholona A Me Na I`a (Botanical/Wildlife Preserves)

Na Mea Kanu (rare plant habitats) of Kahojolaawe, especially at Puju Koe and at Aleale (where the newly discovered genus Ka Palupalu o Kanaloa is located), is designated for the protection of rare native plants. Na Holoholona A Me Na Iya are the designated wildlife habitats. These designated areas are where biological and botanical surveys have found notable species, unique ecosystems, and/or sites that provide good opportunities for cultivating native species. These places will be actively protected from destructive human disturbance, fire, and invasive flora and fauna. Specific land requirements include cleared areas to serve as buffer zones and fire breaks.

4.2.6 Kahua Kahiko (Cultural/Historical Preserves)

A significant number of archaeological studies were conducted on the Island between 1976 and 1980, which identified over 500 sites. The entire Island is listed on the National Register of Historic Places. Initially, all cultural sites (including *koja*) will be identified, accurately surveyed on a map, and protected by a physical buffer of 10 feet. In the future, cultural and educational experts will specify exact sites for use and/or preservation. The Use Plan also designates a large portion of one *ʻili* (Honokoa) as a cultural preserve. The designation will allow future generations of Hawaiians to experience first-hand, the unaltered places of their ancient ancestors and facilitate an intimate connection between the generations. Within this preserve, human activity would be controlled. No improvements will be made except for site protection and restoration purposes.

All of the uses will overlap and activities will serve more than one purpose. Culture, education, and restoration are the basis for all uses and are concepts that have been discussed as separate, but are viewed as elements of integrated use on the Island. Thus, a certain land area may have multiple uses and meanings over time.

The physical linkages between *ʻili* affect the uses within each *ʻili*. Access to different parts of the land and ocean is important and should be provided as an integrated island-wide system.

4.2.7 Kihapai Hoʻioulu Mea Kanu/Punawai (Nurseries/Reservoirs)

The most important factor for the success of restoration and the use of the Island is the availability of water, the harvesting of water sources, and recharge of the water table. Natural water collecting and storage areas in the uplands, such as at Lua Makika, have been identified and have been designated as reservoir areas. These areas are also good sites for plant nurseries, which are needed to help make the re-vegetation efforts more effective. At least one of these reservoir areas will be used as a nursery, depending upon feasibility and compatibility with water development and revegetation activities. Vegetation and soil loss, surface winds, increased runoff, and alien plant introduction have significantly decreased the availability of water. As the Island heals and regenerates, moisture will return to the land. Ecosystem restoration, however, must begin before the regeneration of water sources. The current lack of water presents one of the biggest challenges to achieving the restoration goals for Kahōlawe. To irrigate the number of plants required to revegetate only a small portion of the hardpan will require millions of gallons of water each year at a tremendous financial cost.

The KIRC plans to operate a plant propagation facility on Maui and nursery-holding facilities on Kahōlawe. Kahōlawe's nursery is estimated to demand roughly 500,000 gallons annually for the propagation of mulch crops, seed source, and seedlings for critical erosion areas. Water storage facilities with capacities upwards of 20,000 gallons will be required. The historic ranch cistern, which can be used for supplying water to the nursery, will hold up to 400,000 gallons. Assuming adequate rainfall, an effective means to remove sediments from the runoff, and an ability to store water through the dry season, the ranch cistern above Honokanaiya will be able to meet the demands of the nursery.

Potable (or, "drinkable") water demand for staff and volunteers is probably lower than the sixty gallons/day/person projected for cleanup personnel by the Navy's Kahōlawe Island Water

Supply study. During Protect Kahoʻolawe ʻŌhana access periods, for example, visitors bring their drinking water – less than two gallons/person/day, supplemented by a small catchment system at Hakioawa and salt water from the ocean for bathing. During short-term trips, staff and volunteers will require a minimum of ten gallons per person per day. People living on Kahoʻolawe for longer periods would demand an estimated thirty gallons per day.

Initial re-vegetation efforts will focus on dry-land plants that can survive and reproduce on Kahoʻolawe. Their survival rate with no irrigation was tested during the 1998 dry season. Estimates of the total annual water required for one acre of out-planting is 64,000 gallons.

The KIRC is investigating small-scale collection and storage of a fog drip, although the Island's elevation may be too low for optimum utilization of this technique. At the summit of Lua Makika, significant amounts of dew gather each night on existing plants and soil surfaces. Rock mulching, a traditional Hawaiian planting strategy, captures dew and fog, "sweats" water, and cools plants.

The Island's basal lens is currently too salty for use. Electro-resistivity testing suggests the presence of a small, dike-impounded aquifer in the Island's center, but of unknown quality and quantity. It is believed that the high rainwater runoff and low recharge rates makes use of the basal lens and the perched aquifer unfeasible at the present time. Well development is also expensive. Over time, restored native vegetation will capture atmospheric and surface moisture (i.e., fog and dew) and reduce surface runoff during rains. This, in turn, will facilitate aquifer replenishment, making well development possibly feasible in the future.

Surface runoff from the hardpan is estimated in the tens of billions of gallons. Exposed soils and high levels of sediment make it impractical for catchment and use. Without sealing, covering, or re-vegetating the hardpan surface, sediment removal from surface runoff would overload any filter system currently available. The repair and use of the former ranch cistern faces these challenges.

Kahoʻolawe's annual rainfall averages twenty-five inches at Lua Makika and ten inches along the coast, yet totals tens of billions of gallons each year. Water necessary for successful out-planting is available. The difficulty and expense, however, are in constructing catchment surfaces, storage structures, and distribution systems. The KIRC has already started the construction of a rainwater catchment at Lua Makika, which will be completed by mid November 2002. The rainwater catchment will collect over 600,000 gallons of water per year that can be used for irrigation and other purposes on the Island. To water 150 acres of out-planting, a total of fifteen modules would be required to supply 4 million gallons of water each year.

This water could be used for human consumption, if treated. Filter systems can produce five to six gallons per minute, thereby meeting the needs of 100 people per day. Rooftop catchment systems for potable water will be developed for all buildings constructed.

Small-scale desalinization units produce four to six gallons per hour, and will be used in coastal kahua kauhale. The operating expense and small capacity (300 gallons per day) make them an impractical source for irrigation water. They will be used primarily to supply drinking water in coastal camps. An additional, larger unit at Honokanai'a can produce 9,000 gallons per day. Importing water by boat or pipe from Maui is logistically and financially impractical.

4.2.8 Alaloa (Roads and Trails)

Physical linkages between places on and around the Island are important to integrating the Island as a whole. The connection of different levels -- lihikai, kula, mauka -- and the connection of different uses and activities requires cleared roads, trails, and access routes. Access to different parts of the land and ocean is especially important for subsistence and restoration activities. New roads and trails will be constructed as an integrated island-wide system. An island-circling trail along the shoreline and the coastal cliffs will be constructed for access to fishing areas, subsistence gathering areas, koʻa shrines, coastal camping areas, nurseries, etc.

The existing main four-wheel drive dirt road that follows along the spine of the Island (from Honokanaiya to Lua Makika) will be retained, and has been improved as part of the ordnance clearance project by the Navy. This road connects all ʻili and is currently used for the annual Makahiki ceremony.

On the windward side of the Island, a road from Kuheia to Lua Makika will be reopened in order to provide another major access route to the central part of the Island for supplies, plants, students, and restoration teams. This road will also facilitate access to Moaulanui for training in navigation. Roads will be important in the management of the entire Island, particularly for fire control and for the monitoring of activities on and around the Island.

The system of roads will be utilized as part of a firebreak system developed for the Island. Roads will be constructed or modified to improve the drainage pattern and control erosion on the Island. They will be designated to protect sensitive cultural, archaeological, and flora and fauna habitat sites. The roads should be improved with long-term maintenance in mind and the feasibility of surfacing needs to be studied.

In keeping with the ʻili concept of land use and management, mauka-makai trails will be designed to link the coastline with the mauka portion of each ʻili. This will require new trails to be opened from Honokoa up to the road in the uplands, Makaalae and Kii to Kealialalo, from Ahupu and Ahupuiki to the road through the hardpan, from Papakaiki to Lua Makika, and to Puju Kolekole and Oawawahie from the Hakioawa extension road. In addition, the old ranch road that runs from Kaulana to Ahupu should be restored as a trail.

The trails will be mainly designed for walking; however, some segments may be designed to accommodate motor vehicles. Similar to road alignments, trails will be sited to protect sensitive cultural, archaeological, and flora and fauna features, and to serve as firebreaks where possible.

4.2.9 Refuse

Much of the refuse generated by people on the Island should be carried off the Island when the people leave. A system of sorting and recycling should be implemented. Large-scale refuse collection and disposal systems and landfills are not seen as necessary.

5.0 PRELIMINARY ASSESSMENT

5.1 Renewable-Energy-Based Electrification for Kahojolare

Based on the evaluation of wind and solar data available from the KIRC (see Appendix), three levels of service ranging from PV-lights to full AC electrical service are feasible.

5.1.1 Solar Home Systems for Kahua Hojomoana (Overnight Campsites)

Stand-alone PV-based solar home systems (SHSs) can provide cost effective evening lights and power small DC appliances at each kahua kauhale and kahua hojomoana. The minimal system size, for a nominal load of 40 W of compact fluorescent lights and a power outlet for a small radio or appliance is: 100 Wp of PV; 100 Ah, 12 V deep cycle battery with 8 A charge controller. The design developed by PICHTR for remote villages in Pacific Island nations will be used as a baseline. Methodologies for field installation, sizing PV arrays, and determining their orientation are available from PICHTR.



Solar-Home-System in Vanua Levu, Fiji (PICHTR)

For the kahua kauhale (educational and cultural centers and work camps) the electrical loads can be met with two levels of service depending on requirements. For kahua kauhale sites with structures requiring about 1 kWh daily service PV-hybrid systems could be used, and for sites with larger electrical loads wind/PV hybrid systems might be necessary. However, given the KIRC vision statement, it may not be appropriate to use wind-turbine-generators because of their visual impact.

5.1.2 Small Distributed PV-Hybrid Systems for Kahua Kauhale

The “small distributed PV-hybrid power systems” or hybrid-home-systems (HHSs) can supply continuous AC electricity. Simply stated, the idea is to connect hybrid systems like the ones used by off-grid single residencies in Hawaii to the facilities envisioned for each kahua kauhale through a small grid. Hybrid systems consisting of PV arrays, inverter, battery and fossil fuel generator sized at 2 to 5 kW have been used since the 1980’s in off-grid residencies.

There are three main prerequisites for the deployment of HHSs:

1. The maximum distance from the inverter source of AC power to the user is about 450 feet when the distribution voltage is 240V.
2. The system will require intermittent service by a person trained to fuel and maintain the diesel generators, water the battery and place inverters in and out of service.
3. If applicable, an organization must be available for the collection of funds from the sale of electricity.

5.1.3 Hybrid Power Systems for larger Kahua Kauhale (~ 500 to 1500 kWh/day)

PICHTR designed, trained operators, and developed operational guidelines for a 720 kWh/day renewable-energy-hybrid-power system at the Nabouwalu Provincial Center in Fiji (offices, shops, ice-plant, bakeries, 30-bed hospital, school, post office, police station and village).

The renewable energy hybrid power system consists of wind turbines, PV modules, 240 VDC flooded lead acid battery, and 100 kVA rotary inverter. Upwards of 70% is supplied with the renewable energy equipment and the balance with diesel generators. Electricity is distributed through a small grid with a radius of a couple miles. The system produces electricity at costs that are competitive with the true cost of electricity production with fossil fuels. PICHTR operates a test site for wind/PV hybrid and PV-lighting systems at Kahua Ranch on the Big Island.

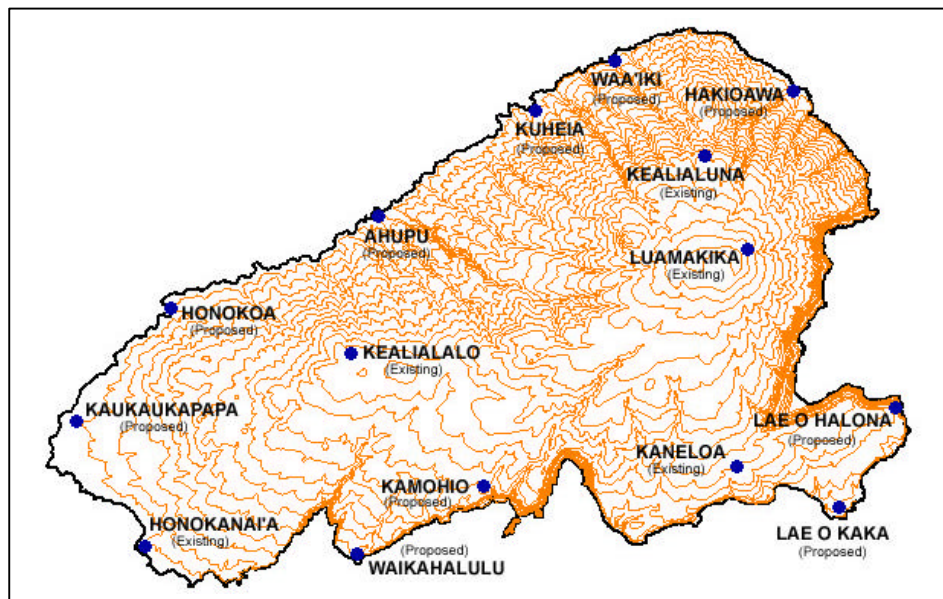


Nabouwalu Wind/PV Hybrid Power Plant (PICHTR)

6.0 FOLLOW-UP ACTIONS & RECOMMENDATIONS

The preliminary assessment of solar and wind resources on Kahoʻolawe indicates that there is adequate renewable resources to support alternative energy technologies. Given this circumstance and positive assessment, it is recommended that the State of Hawaii pursue the following actions and recommendations.

1. Exemption from Public Utilities Commission (PUC) Oversight and Regulation. In order to ensure smooth implementation of technologies to support the re-vitalization of Kahoʻolawe it is recommended that the State of Hawaii provide statutory exemption from the oversight and regulation by the PUC
2. Additional Data Collection Sites. Additional data collection sites will be critical to supporting the long-term development of the alternative energy future for Kahoʻolawe. A number of sites were installed by the Bureau of Land Management (see map below), which resulted in the collection of data used in the preliminary assessment. However, several additional sites at targeted encampment locations are required to ensure the adequate renewable resources exist at those sites. For sites identified with potentially usable wind resource based on measurements performed at 10 meters above ground, it is recommended that wind speed measurements at heights of at least 30 meters above ground be obtained;



Existing and Proposed Weather Monitoring Stations on Kahoʻolawe

3. Development of Model Encampment. Currently, the Island is supported through the use of a U.S. Navy diesel generator, which powers the major encampment with constant air conditioning and other modern conveniences. The KIRC does not anticipate such requirements for future activities on Kahoʻolawe. Instead, the encampments envisioned would involve minimal power and little or no modern conveniences. As such, the development of a model encampment is necessary to determine the energy requirements

as well as logistical issues relating to this vision. Funding to support the construction of such an encampment powered by renewable energy system (solar home system) with prepayment meter and data collection equipment is recommended; and

4. Ongoing Evaluation of Long-Term Alternative Energy. While the previous actions & recommendation are short-term in nature, there are on-going requirements for the evaluation of alternative energy applications to support the future vision and activities for Kahoʻolawe. The KIRC will continue its deliberations with respect to the future improvements for the Island to support the archeological, cultural, historical, and restorative activities. Based on preliminary plans, the following is a short list of requirements and possible alternative energy solutions:

Pumping of fresh water – wind pumped hydro, pumps powered by renewable sources;
Desalinization – portable desalinization unit powered by renewable sources, ocean thermal energy conversion OTEC;
Ice production – direct ice production from renewable sources;
Transportation for all terrain vehicles – bio-diesel, hydrogen.

6.1 PRELIMINARY COST ESTIMATES FOR FOLLOW-UP ACTIONS

1. Exemption from PUC Oversight and Regulation: There is no direct cost associated with this item. The KIRC and PICHTR staff will work with the PUC staff in obtaining the exemption. Any cost associated will be staff time required for meetings and preparation of necessary paperwork.
2. Additional Data Collection Sites: Due to the uncertainty in extrapolation of wind data from 10m to 30m elevations, ten new weather-monitoring stations of full 30m heights are being proposed at the cost of \$10,000 per station. Total cost of additional data collection is \$100,000.
3. Development of Model Encampment: The KIRC is currently developing plans for a kahua kauhale at the summit of the Island, which will be used as the model encampment. The cost of the alternative energy portion of the project, including design, purchase and transportation of necessary equipment, and installation of the system on Kahoʻolawe is estimated to be \$250,000.
4. Ongoing Evaluation of Long-Term Alternative Energy (LTAE): The estimated cost of ongoing evaluation of long-term alternative energy is \$150,000.

The \$500,000 request will fund, over six to nine months of calendar year 2004, the four activities listed above.

Summary of Cost Estimate

Action	Cost
Exemption from PUC Oversight and Regulation	0
Additional Data Collection Sites	\$100,000
Development of Model Encampment	\$250,000
Ongoing Evaluation of Long-Term Alternative Energy (LTAE)	\$150,000
TOTAL	\$500,000

7.0 CONCLUSIONS

The revitalization of Kahoʻolawe represents a unique opportunity to build a sustainable development model for the World based on innovative alternative energy and environmentally conscious technologies. The use of such technologies is critical to ensuring compliance with the cultural, educational, and historical governing principles envisioned for the Island.

In consideration of preliminary data gathered and assessment of such data, it is concluded that the use of alternative, renewable energy to support the revitalization and ongoing activities for Kahoʻolawe Island is feasible and can be practically implemented in a cost conscious and sustainable fashion.

The Kahoʻolawe Island Reserve Task Force on Alternative Energy recommends that the following actions:

The 2004 Legislature of the State of Hawaii provide \$500,000 to PICHTR for the:

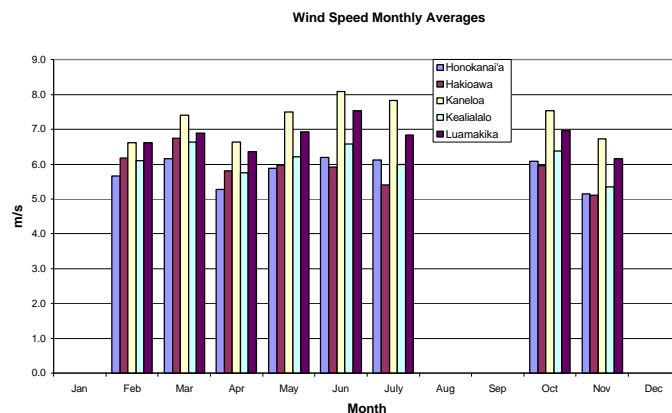
- Installation of additional data gathering stations at sites targeted for future encampments and/or activities and additional anemometers for targeted wind resource sites at heights of at least 30 meters above ground level;
- Development of a model encampment site and demonstrate the feasibility of the use of alternative energy (photovoltaics) as well as to gather critical use data for such sites;
- Continued feasibility assessment and planning for implementation of alternative energy to ensure that future energy requirement for Kahoʻolawe Island are based on alternative energy sources (i.e. wind, solar, ocean thermal, biomass based, hydrogen).
- Exemption of Kahoʻolawe Island from oversight and regulation of the PUC

The KIRC and the Kahoʻolawe Island Reserve-Alternative Energy Task Force (KIR-AETF) requests that the Legislature provide additional two years for implementing the recommendations at the end of which the KIRC and KIR-AETF will provide a comprehensive report to the Legislature. The KIRC and KIR-AETF greatly appreciates the opportunity to submit this final report to the 2004 Legislature of the State of Hawaiʻi.

8.0 APPENDIX 1.

Kahojōlawe Weather Stations Wind and Solar Radiation Data (October 2001 to July 2002)

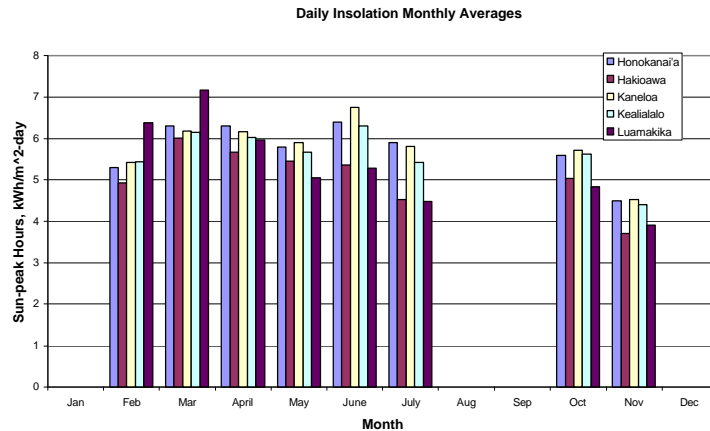
Wind Records: To produce electricity for less than 0.08 \$/kWh, annual **averages** of at least 7.5 m/s at heights of 30 m above ground are required. As shown in the following Figure and Table, the 10-month data available indicate annual average wind speed ranging from 5.8 m/s (Honokanai'a) to 7.3 m/s (Kaneloa) at 10 m above ground. Extrapolation to elevations of 30 m above ground (hub height for wind turbine generators) indicates that averages might range from 6.8 m/s to 8.5 m/s respectively. **Therefore, these sites should be evaluated for potential development of their wind resources.** Would need information about development and usage envisioned for sites as well as additional anemometry.



Month	Wind Speed @ 10 m				
	Honokanai'a	Hakioawa	Kaneloa	Kealialalo	Luamakika
Jan					
Feb	5.7	6.2	6.6	6.1	6.6
Mar	6.2	6.8	7.4	6.6	6.9
Apr	5.3	5.8	6.6	5.8	6.4
May	5.9	6.0	7.5	6.2	6.9
Jun	6.2	5.9	8.1	6.6	7.5
July	6.1	5.4	7.8	6.0	6.8
Aug					
Sep					
Oct	6.1	6.0	7.5	6.4	7.0
Nov	5.1	5.1	6.7	5.4	6.2
Dec					
Average:	5.8 m/s	5.9 m/s	7.3 m/s	6.1 m/s	6.8 m/s
Extrapolated					

to 30 m: 6.8 m/s 6.9 m/s 8.5 m/s 7.2 m/s 7.9 m/s

Insolation: As shown in the following Figure and Table, with average annual insolation ranging from 5.1 kWh/m²-day (Hakioawa) to 5.8 kWh/m²-day (Kaneloa) these sites have the solar resource required to produce cost effective electricity in remote locations (*remote means stand alone PV system required*).



Month	Sun-Peak Hours (kWh/m ² -day)				
	Honokanai'a	Hakioawa	Kaneloa	Kealialalo	Luamakika
Jan					
Feb	5.3	4.9	5.4	5.5	6.4
Mar	6.3	6.0	6.2	6.2	7.2
April	6.3	5.7	6.2	6.0	6.0
May	5.8	5.5	5.9	5.7	5.1
June	6.4	5.4	6.8	6.3	5.3
July	5.9	4.5	5.8	5.4	4.5
Aug					
Sep					
Oct	5.6	5.0	5.7	5.6	4.8
Nov	4.5	3.7	4.5	4.4	3.9
Dec					
Average:	5.8 hours	5.1 hours	5.8 hours	5.6 hours	5.4 hours

For reference, the following Figure compares the solar resource in Honokanaiya with the resource at the PICHTR Test Center at Kahua Ranch

